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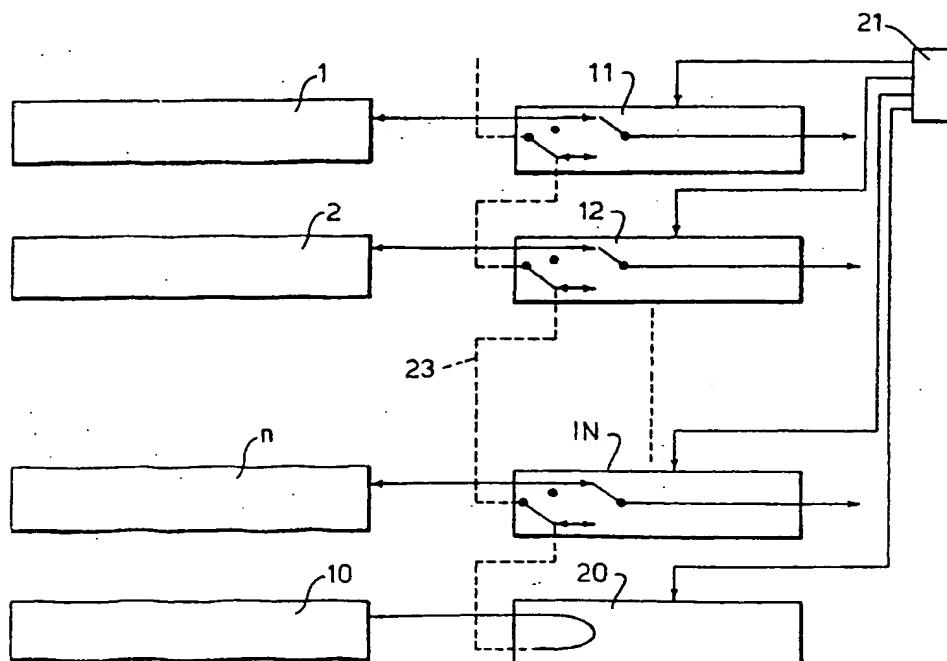
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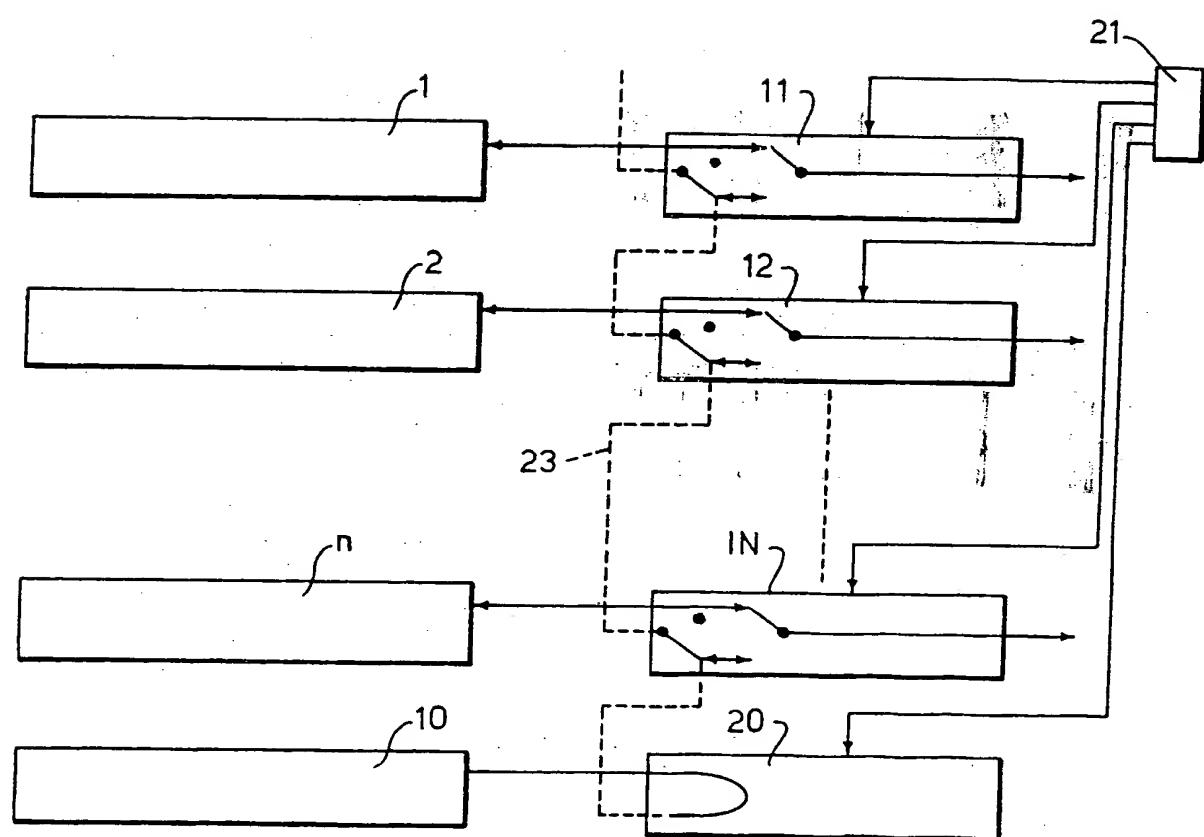
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## (54) Telecommunications system protection scheme

(57) In a SDH telecommunications system including a plurality of tributary cards 1...n through which signals are switched, a protection card 10 is included for the tributary cards and a multiplex controller 21 controls the output of a plurality of line termination (LTU's) 11...20 units there being one unit provided respectively for each tributary card including the protection card, the multiplex controller being arranged to switch signals from a faulty tributary card to the protection card through the LTU 20 associated with the faulty tributary card but without involving any switching taking place within the faulty tributary card so as effectively to replace the faulty tributary card.



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TELECOMMUNICATIONS SYSTEM PROTECTION SCHEME

This invention relates to a telecommunications system protection scheme for protecting tributary cards in the system and enabling them to be replaced when faulty.

The system is one which operates on the synchronous digital hierarchy (S.D.H.) and 5 the information is transmitted in bit form in a series of bytes of information. The information is sent at 34/45 and 140 megabit levels and incorporates the add drop multiplexer system. This is usually referred to as an AdMux. The invention is intended as a protection scheme against card failure and as a maintenance tool to minimize disruption of tributary traffic during tributary card replacement. The mechanism should not affect the 10 external traffic interfaces and protection is provided only for the tributary cards and with signals being supplied to and received from the same traffic ports before and after switching between cards.

According to the present invention a SDH telecommunications system includes a 15 plurality of tributary cards through which signals are switched, a protection card is included for the tributary cards and a multiplex controller controls the output of a plurality of line termination (LTU's) units there being one unit provided respectively for each tributary card including the protection card, the multiplex controller being arranged to switch signals from a faulty tributary card to the protection card through the LTU associated with the faulty 20 tributary card but without involving any switching taking place within the faulty tributary card so as effectively to replace the faulty tributary card.

Thus the protection switching is effected without any involvement of the failed card. The present invention thus guarantees the successful operation of the protection system irrespective of the failure mode of the tributary card. This would not be the case where the protection operation pretended upon some functional involvement of the faulty tributary  
5 card.

The switching between cards may be done automatically under the control of the multiplex controller or alternatively it may be hand controlled. In the latter case it will be controlled via a suitable management interface of the network.

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The arrangement is preferably such that when the faulty tributary card has been replaced, the controller will switch out the protection card and revert to the use of the tributary card.

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In this invention it is necessary that for automatic operation, the protection switching shall be performed on the following internally detected criteria, the following of which are examples:-

- (a) internal interface check disparity errors
- (b) failure to respond to control poll
- 20 (c) failure of control bus protocol checks
- (d) maturing of on-card watchdog timer
- (e) on-card program checksum error
- (f) failure of on-card ASIC poll cycle

## (g) ASIC internal buffer overflow/underflow

In order that the protection switching, whether it is automatic or manual, takes place correctly, the following sequence of events has to be followed:-

- 5        1        the switch card protection must be disabled to the protection card
- 2        traffic is duplicated to the protection card
- 3        the protection card is down-loaded with its configuration
- 4        the output buffer on the failed card is disabled and the associated LTU is switched.
- 10        5        the protection output buffer on the buffering card is then enabled.

It will be appreciated that there will be some delay in the transmission of information during the switching from a faulty tributary card to the protection card. If the 15 system is operated on automatic control under the control of the multiplex controller, normally such switching should be completed within 3 seconds of detection of a fault condition at the tributary card. With manual operation however, switching is preferably completed within 8 seconds, which is the time measured from the entry of the command at the appropriate interface to the confirmation to the operator.

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It will be appreciated that during the period in which the selected input traffic is switched over, errors will be generated in the container bytes. For compatibility with the switch unit protection mechanism, or to prevent an indication of switch unit failure in the case of an unprotected switch unit, the maximum duration of any disruption of traffic from

the output of the switch unit, due to switching between tributary cards, will be within the persistence check period of the switch diagnostic message check.

In order that the invention may be readily understood, one example of the switching system architecture embodying the invention will now be described, with reference to the single figure of the accompanying drawings which show in diagrammatic form the connections between the tributary cards being protected and the multiplex controller.

The figure shows the tributary cards "1" to "n" and a protection card "10". Each of the tributary cards is connected to a line termination unit (LTU) respectively "11", "12", "1n", and the protection card "10" is connected to its own LTU "20". Each of the LTU's is connected to a multiplex controller "21", as shown, and each of the LTU's, apart from the LTU 20, has a switching mechanism which is connected to a protection bus "23" so that the LTU "20" can be switched through to one of the other appropriate LTU's. Each of the units also has an output port. Thus any plesiochronous digital hierarchical signal (P.D.H.) received on an LTU can be routed either directly to the card associated with the LTU or to the protection bus "23". All switching is under the control of the controller "21" and operation of the switch automatically disconnects the rest of the protection bus to the left of the card being protected, as viewed in fig. 1.

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In this example there are five protection buses, three for 34/45 megabits, one for 34 megabit transmux, and one for 140 megabit signals. The "a" connections on the termination units of the 34 megabit cards are connected to the 34 megabit protection bus "1" and the "b"

terminals to the 34 megabit protection bus "2", etc. The 140 megabit card will only use the termination terminal "d" which has access to the 140 megabit protection bus. The 34 megabit transmux card will use the termination unit, terminal "a". The protection card "10" is located in the slot in the switching assembly immediately to the right of the tributary 5 cards "1" to "n" to be protected. In the termination unit slot associated with the protection card, the related protection termination unit is inserted. This unit connects the protection bus to the inputs and outputs of the protection card.

It will be appreciated that in operation one of the tributary cards, "1" to "n", will be 10 immediately switched out of action and the protection card will be switched into circuit. The protection card "10" will then route via the unit "20" onto the appropriate protection bus "23" to the relevant LTU so that transmission can continue. This provides an effective and swift re-routing of signals and enables the protection to operate so that the system is not out of action while a working card is changed. When the working card has been replaced 15 the system automatically changes back and the protection card "10" is cut out of operation.

CLAIMS

1. A SDH telecommunications system including a plurality of tributary cards through which signals are switched, a protection card is included for the tributary cards and a multiplex controller controls the output of a plurality of line termination (LTU's) units there being one unit provided respectively for each tributary card including the protection card, the multiplex controller being arranged to switch signals from a faulty tributary card to the protection card through the LTU associated with the faulty tributary card but without involving any switching taking place within the faulty tributary card so as effectively to replace the faulty tributary card.
2. A telecommunications system as claimed in Claim 1 in which there are means to automatically effect the switching between the cards.
3. A telecommunications system as claimed in Claim 1 in which there are means to enable manual control of the switching between the cards.
4. A telecommunications system having the arrangements substantially as hereinbefore described with reference to the accompany drawing.

**Patents Act 1977**  
**Eaminer's report to the Comptroller under Section 17**  
**(The Search report)**

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**Relevant Technical Fields**

(i) UK CI (Ed.N) H4K: KTL. H4M: MP  
 (ii) Int CI (Ed.6) H04J, H04Q

**Search Examiner**  
**AL STRAYTON**

**Databases (see below)**

(i) UK Patent Office collections of GB, EP, WO and US patent specifications.

**Date of completion of Search**  
**17 MAY 1995**

(ii) ONLINE: WPI.

**Documents considered relevant following a search in respect of Claims :-**  
**ALL**

**Categories of documents**

X:	Document indicating lack of novelty or of inventive step.	P:	Document published on or after the declared priority date but before the filing date of the present application.
Y:	Document indicating lack of inventive step if combined with one or more other documents of the same category.	E:	Patent document published on or after, but with priority date earlier than, the filing date of the present application.
A:	Document indicating technological background and/or state of the art.	&:	Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages		Relevant to claim(s)
A	GB 2278981 A	(GPT)	
A	GB 2266644 A	(GPT)	

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